Air Force Contribution to GMAIC

for

SIC Estimate on Science Technology

Terms of Reference - Appendix C, 1A, 1 & 5

Present and Future Capabilities in Military Research and Development as Related to Offensive Missile and Space Systems

General

Science, as are all other aspects of support or potential support to means of production, is a tool of the state that is used to further the Soviet ideological goals. The tasks set for Soviet science are those that will most profitably enhance the capabilities of the military and industry. In turn, the capabilities are the means for expansion of the Soviet sphere of influence.

The Soviet hierachy has expended sizeable amounts of effort and resources to form a solid base for the expansion of science, and, for planning purposes, is relying heavily upon the anticipated results. Many of the expected results have been isolated, and have been handed to the scientific community as task assignments.

The attention and resources lavished upon science include the establishment of a social prestige level second only to that of the Communist Party itself, and the provision of superior living standards to the members of the scientific community. Further, many of the members are allowed to remain semi-aloof from the political demands that normally require repeated demonstrations and assertions of loyalty.

As an adjunct to the long range support planned for science, the Soviets have carefully alinged their educational systems toward providing steadily

increasing numbers of trained scientists and engineers, and have included new and expanded research facilities as goals of their current Seven Year Plan. As examples, a 35% increase in the number of trained scientists and engineers is planned for accomplishment by 1967, as is the construction of some 190 new research facilities, including two new "science cities" being established in areas east of the Ural Mountains to undertake expansion and exploitation of scientific resources throughout the Soviet land mass.

Physical Sciences in Support of Missile and Space Capabilities

Because of a lack of some types of equipment, much of the Soviet work appears to lag that of the U.S. The Soviets are, however, believed to be on a par, or are leading such areas as celestial mechanics, meteoric research, the study of variable stars and asteroids, and in some areas of supportive mathematics.

While the U.S. has made significant practical contributions in celestial mechanics, the Soviets appear to have developed new general principles pertaining to the motion of bodies with varying mass. Also, the Soviet work in nonlinear mechanics and general mechanics is considerably ahead of similar work in the U.S., and is expected to have increased application in the investigation of stability of orbits, and in the development of control systems.

Through radio astronomy, the Soviets have, since 1947, delved into the investigation of cosmic rays, magnetohydrodynamics, turbulence,

polarization, and interstellar magnetic fields. Despite considerable interest in these areas in the U.S., the Soviets are probably world leaders in this type of research, and it is believed that some of this Soviet work is directly aimed at the isolation and ultimate use of new sources of energy.

Competent Soviet work in several other areas has been noted (geodesy, study of the moon and the planets, general studies in gas dynamics, and some work in cybernetics and automation).

Soviet Advanced Research

a. General

The broad Soviet national policies and plans are oriented toward, and will become increasingly dependent upon, technological advancement for the extension of Soviet influence. The development of contemporary air weapons undoubtedly continues to be a necessary part of the Soviet plans. A clear military superiority (not yet attained) is required, however, before the undertaking of any actions that may require the exercise of the Soviet long range strike arm.

The Soviets lead the U.S. in the system development of powerful rocket boosters, and are expected to increase this lead time insofar as functional applications in space through the use of the boosters are concerned. The estimates of future Soviet rocket capabilities represent the probably extensions in engineering that will be attained. Only limited intelligence is available concerning advanced Soviet applied research that will allow continued growth of Soviet rocketry after the

the technical growth limits of the present design practices are reached. This is to say that the rocket design concepts now receiving the Soviets attentions do have limits of growth potential, and that intelligence has not yet detected significant research gains associated with more advanced development of rocket technology. There is, however, some evidence of Soviet research directed at more distant propulsion systems, such as electron or plasma engines, etc. The significance of the Soviet position lies in the fact that new design concepts will require several years of development before they may be incorporated into the operational side of rocket technology, but the expected level of associated research and testing has not yet been detected.

It is believed that the Soviets have recognized this potential deficiency, and that the recent organizational realignments and the establishing of a very powerful committee to insure coordination between research and hardware development were undertaken to avoid reaching a status wherein engineering and technological advances must halt to await progress in research. Further, the desirability or requirement for a clearly decisive warfare capability will very likely also prove to be dependent upon science, through the development to advanced weapon concepts - weapons not directly related to aircraft or missiles. Indications have been noted that tend to confirm the existence of such projects. There is no evidence, however, of the present existence of a superior Soviet

advanced weapon, nor is there intelligence that has been recognized as indicative of a significant scientific accomplishment that would predict the near-future successful development of such a weapon.

b. Advanced Weapon Concepts

Soviet research that will provide necessary background knowledge for several advanced warfare techniques is being actively supported. Because of the nature of this research, three new concepts for defense in warfare appear suspect:

1. The use of high intensity electromagnetic radiation directed to an aerospace target.

2. The use of beams of particles accelerated to relativistic speeds and directed to an aerospace target.

3. The use of plasma "bodies", generated and accelerated to a target, or generated for use as a coupling mechanism to facilitate destruction through concentrated electromagnetic energy (as in technique 1, above).

The Soviet research efforts associated with the radiated, particle, and plasma investigations are being conducted in more than a dozen laboratories, and have attracted scientific contributions from several Russian scientists internationally recognized as world leaders in science. The Soviet installation of experimental equipment designed to test one or more of these weapon concepts under simulated operational conditions is expected to take place before the end of the period covered by this estimate.

One additional advanced technique that is receiving Soviet attention is experimentation with ionospheric modification. The practical significance of this Soviet research is the extension and control of communications, ECM radiation, and possibly eventual selective control of the intensity and composition of the solar radiation reaching the earth.

Production Techniques

Cybernetics

Cybernetics is of great importance in the Soviet effort toward automation of industry. In recent years, cybernetic devices have been developed with increasing rapidity. Extremum regulators have been developed to make possible the automation of complicated technological processes which otherwise would not be practical.

The Soviets are developing "learning machines" for controlling industrial processes but, evidently, have not yet applied them. It is expected, however, that controlling machines of this type will be introduced experimentally in the near future.

In the field of automation of process-type industries (e.g., petroleum refining) the Soviets will probably solve most of their problems of control, not by the use of electronic means, but rather by using simple, inexpensive reliable pneumatic and hydraulic devices, many of which are already available. The reliance upon these will greatly facilitate Soviet introduction of cybernetic devices into practical industrial automation and will aid in creating systems of high reliability.

The future of the Soviet industrial automation program probably will rely on the widespread use of cybernetic means, from simple searching and memory devices to special computing and learning machines, Much of the latter equipment will utilize "building block" techniques for maximum interchangeability of parts.

Space Sciences

The character of the Soviet space program, as evidence by the number and scope of experiments thus far conducted, reveals an early interest in manned space flight. It is clear that the Soviet scientists and technicians systematically set about identifying the problems associated with space flight, accumulating the necessary pertinent data and applying the solutions to the problems in a practical program aimed at manned space flight. The singularity of purpose in accomplishing definite objectives in an orderly progression also reveals that the space program is well conceived, exceptionally well directed, and boldly executed. Functionally the space program can be categorized into five classes of activity:

1. Vertically Fired Rockets

In general, vertical rockets have been one of the most extensively used research vehicles for investigation of near-earth space. This program has furthered the development of stabilization control, orientation equipment, and recovery techniques; the determination of bio-physical parameters for

man-in-space; the testing of scientific instrumentation and orbital vehicle systems, and the collection of environmental data. No new capabilities in space craft systems have been recently revealed by vertical firings, and it is expected that only occasional vertical firings will be made in the future, as greater use will be made of earth satellites to gather data.

2. Non-Orbiting Surface-to-Surface Systems

While these systems have not been positively identified as having been used in the Soviet space program, it is believed likely that some of the firings currently classed as ICBM research and development may have had as their primary objective the testing of space vehicles (re-entry capsule).

3. Earth Satellite Systems

These vehicles have been used for the scientific study of the upper atmosphere of the earth and near-earth space. They have been used to conduct a broad range of biomedical studies on the affects of cosmic conditions upon life; and of equal importance, they have provided a psychological impact upon the world in that they created an image of the USSR as the foremost nation in space. Prior to the manned conquest of cis-lunar space, it is expected that the Soviets will need to place satellites into highly elliptical orbits to determine the detailed composition of the Van Allen radiation belts. It is expected that they will orbit large satellites equipped to make spectroscopic examinations of the sun, planets, and other astronomical structures, to determine the extent to which they influence the space environment.

4. Lunar Space Craft

It is believed that the Soviets will continue to use and improve their current lunar probe capability. Such endeavors may include lunar satellites, lunar soft landings, lunar soft landings and return with actual samples of the lunar surface, lunar exploration by unmanned vehicles, and finally true lunar exploration by manned vehicles.

5. Interplanetary Systems

It is expected that the early interplanetray probbs will be instrumented for the investigation of the physical parameters of interplanetary space and the planets Mars and Venus. Included will be studies of the solar atomosphere and radiations, interplanetary matter, gravitational and electromagnetic fields, solar system distances, and how the properties of interplanetary space are affected by the sun, the solar system itself, and by sources from without the solar system.

The Soviet capability to combine extreme accuracy of optical observations with, apparently, a minimum loss time in the transmission of tracking, command and control data to and from the coordinating - computing - control center is sifficient to accomplish any space mission within the capabilities of their propulsion systems during the 1961 - 1971 time period. Evidence is available on the existence of electronic equipment which is suitable for the detection of a "dark" (non-cooperative) satellite. It is also estimated that the Soviets have the capability of maintaining surveillance over a fairly large number of space objects.

The Soviet approach to space communications has been simple and direct, utilizing existing reliable transmission methods along with off-the-shelf equipment. Miniaturization has not been a prime requirement because of the large propulsion capability of their rockets. Advancements in communication capabilities are likely to be realized by improvement of equipment rather than introduction of new or novel techniques. Such improvements will include more extensive use of transistors, parametric amplifiers, improved antenna systems, more snesitive receivers, and power sources with higher capacity and efficiency.

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Space systems which could have potential military applications include Space Plane (a single-stage-to-orbit, recoverable, aerodynamic vehicle powered by a hyperjet, multicycle, air breathing prppulsion system) earth satellites and manned glide type vehicles.

It is believed that the USSR is not capable of achieving Space Plane during the period of this estimate.

The Soviets are presently capable of placing 10,000 to 12,000 pounds into a 300 mile orbit and could develop a workable, orbital bombardment satellite within the next one to three years, depending upon the degree of effort put into the development. They are estimated to be capable of orbiting manned or unmanned, maneuverable earth satellites from 50 to 100 tons on individual launches in the 1967-1970 time period.

By the 1967-1970 time period the Soviets will have the technical capability to develop manned, advanced performance, winged vehicles, which could have reconnaissance, support and/or weapon delivery capabilities.

It is important to recognize that any Soviet space development, manned or unmanned, regardless of the guise under which it is prosecuted, has potential military application. For this reason the amount of effort devoted to any particular system will be determined by the current military requirements.